

# Technical considerations in patients undergoing combined aortic valve replacement and aortocoronary bypass surgery

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**SUMMARY** Forty-nine patients have undergone combined aortic valve replacement and aortocoronary saphenous vein bypass graft surgery using a technique of distal coronary perfusion. Vein grafts are placed before replacement of the aortic valve, and continuously perfused by siting the proximal anastomoses high on the aortic root or individually perfusing the grafts before proximal anastomosis. Continuous coronary ostial perfusion is used as well during aortic valve replacement. There were 3 (6.1%) operative deaths and 1 (2%) perioperative myocardial infarction.

A comparison of this technique with other reported results suggests that attention to myocardial perfusion distal to significant coronary artery stenosis may decrease the incidence of perioperative myocardial infarction in patients requiring both aortic valve replacement and coronary bypass graft operation.

We are now being asked to see a significant number of elderly patients with combined aortic valvular and coronary artery disease. These patients, with a myocardium often damaged by prior infarction and jeopardised by marginal blood flow, have generally been thought to be at increased risk during aortic valve replacement (Berndt *et al.*, 1974; Rossiter *et al.*, 1975) and many have hitherto been deemed inoperable.

To minimise the risk of operation in these patients we have adopted an operative technique which ensures maximal myocardial blood flow throughout the procedure. This report summarises our experience to date with this technique.

## Subjects and methods

From May 1960 to December 1976, 49 patients underwent combined aortic valve replacement and aortocoronary saphenous vein bypass surgery at St. Vincent Hospital, Portland, Oregon, using a technique of distal coronary perfusion to be described. Preoperative clinical and catheterisation data are listed in Table 1.

The nature and probable aetiology of the aortic valve lesion were determined from clinical, catheterisation, and operative findings, and are listed in

Table 1 Clinical and diagnostic data

Number of patients		49
Sex	Male	35
	Female	14
Mean age		63.6 years
Age range		44-81 years
Severity of angina	None	6
	Mild	10
	Moderate	23
	Severe	10
Prior myocardial infarction		9
NYHA Functional Class (%)	I	17 (35%)
	II	12 (24%)
	III	18 (37%)
	IV	2 (04%)
Catheterisation data (number of values)	RA mean	4.5 mmHg (31)
	RV	38/6 mmHg (33)
	PA	35/14 mmHg (35)
	PA mean	22.7 mmHg (27)
	LV	108/17 mmHg (35)
	Aorta	133/63 mmHg (42)
	Cardiac index	3.0 l/min per m <sup>2</sup> (28)
	PVR	2.1 Units (21)
	Gradient (AS only)	69.5 mmHg (22)

RA, right atrium; RV, right ventricle; PA, pulmonary artery; LV, left ventricle; PVR, pulmonary vascular resistance; AS, aortic stenosis.

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Table 2. The principal indications for aortic valve replacement are in Table 3. The implanted prostheses used were Starr-Edwards Model 1260 (N = 23), Model 2310 (N = 2), and Model 2400 (N = 24).

Eighty-two vein grafts were placed for significant (> 50%) coronary artery stenoses, with or without angina. The distribution of vein grafts is listed in Table 4. Fifteen patients underwent concomitant surgical procedures as noted in Table 5.

### Operative technique

All patients undergoing combined aortic valve replacement and aortocoronary bypass graft surgery were placed on high-flow cardiopulmonary bypass after median sternotomy incision. The patient was cooled to 30°C on bypass, the heart electrically fibrillated, and the aorta cross-clamped. The saphenous vein was removed from the leg and a segment of appropriate length anastomosed proximal-vein-to-distal-coronary-artery using a continuous suture of 6-0 or 7-0 Prolene. The heart was then defibrillated and the cross-clamp repositioned to a side-biting position high on the aortic root where the proximal anastomosis was performed. Additional grafts were placed as needed in a similar fashion in sequence, thus allowing coronary perfusion between brief periods of aortic cross-clamping. In the event of a short or diseased aortic root, the proximal anastomoses were occasionally delayed to allow perfusion through the vein grafts during aortic valve replacement. This technique was also frequently used on the right vein graft to avoid kinking of the graft and to improve exposure during aortic valve replacement. After coronary artery bypass, the aorta was again cross-clamped below the ostia of the vein grafts, to provide perfusion of the distal coronary artery (Fig. 1). The aortic root was opened transversely, the coronary ostia cannulated, and the aortic valve replaced using continuous coronary perfusion at 30°C in the beating heart. After valve replacement, any remaining proximal anastomoses were then performed with partial aortic occlusion and with the heart beating.

### Results

#### OPERATIVE MORTALITY

Three patients (6.1%) died from events causally or temporally (< 30 days) related to their operation. This is not significantly different from our operative mortality for aortic valve replacement alone in an age- and sex-matched population operated at this institution over the same period. One patient died

Table 2 *Nature and aetiology of aortic valve lesions*

<i>Lesion</i>	<i>No.</i>	<i>Lesion</i>	<i>No.</i>
Aortic stenosis	30	Bicuspid	9
Aortic regurgitation	9	Rheumatic	7
Mixed	10	Atherosclerotic	33

Table 3 *Aortic valve replacement and aortocoronary bypass surgery*

<i>Indications for AVR</i>	<i>Associated angina</i>	
	<i>Yes</i>	<i>No</i>
Lesion only	7	3
+ CHF	25	1
+ CHF, syncope	11	2
Total	43	6

CHF, congestive heart failure.

Table 4 *Distribution of vein grafts*

<i>Coronary artery</i>	<i>No. of vein grafts</i>
Right	24
Left anterior artery	35
Diagonal	1
Obtuse marginal	22
Total	82
	Average—1.7 per patient

Table 5 *Associated surgical procedures*

<i>Procedure</i>	<i>No.</i>
Right coronary endarterectomy	6
Septal myotomy	2
Ascending aortoplasty	2
Left coronary endarterectomy	1
Permanent pacemaker	1
Resection of ventricular aneurysm	1
Mitral commissurotomy	1
Resection ascending aortic aneurysm	1
Total	15

from a sudden arrhythmia 12 hours after operation. A second patient who underwent associated ascending aortoplasty for cystic medial necrosis died of haemorrhage from a suture line disruption on the 5th postoperative day. The third patient experienced bleeding from a stress ulcer on his 8th postoperative day and required total gastrectomy to control haemorrhage. He died 10 weeks after cardiac surgery from intra-abdominal sepsis and renal failure. Necropsy in all 3 cases disclosed an unremarkable prosthesis, patent grafts, and no evidence of myocardial infarction.

#### OPERATIVE MORBIDITY

There were 10 postoperative complications in the 46 operative survivors (Table 6). One patient with

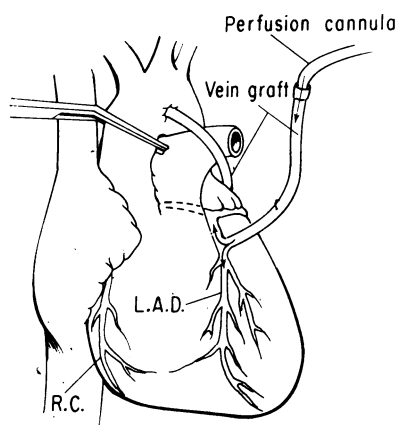


Fig. The heart before aortic valve replacement. Note the graft to the obtuse marginal coronary artery high on the aortic root and a perfusion cannula in the graft to the left anterior descending coronary artery, ensuring continuous distal coronary perfusion during subsequent valve replacement.

Table 6 Operative morbidity

Complication	No. of patients
Thoracic haemorrhage	6
Pulmonary oedema	2
AV block requiring pacer	1
Myocardial infarction	1
Total	10 (= 22%)

Table 7 Late death

Cause (months postop.)	No. of patients
Congestive heart failure (11)	1
Myocardial infarction (6)	1
Thrombotic stenosis of the prosthesis (39)	1
Sudden unknown (7)	1
Accidental (22)	1
Total	5 (= 11%)

angina, triple vessel coronary artery disease, and NYHA Functional Class IV congestive heart failure suffered a postoperative myocardial infarction, as defined by the appearance of persistent ST segment elevation in his inferior electrocardiographic leads and a creatine kinase of 1178 units. There were no q waves. His recovery was uneventful.

#### LATE DEATHS

There were 5 late deaths (11%) at a mean follow-up of 1.5 years. Causes of late death are listed in Table 7.

#### Discussion

The necessity for 'myocardial protection' in aortic valve replacement has been a source of considerable debate in the past. Though we have always advocated coronary ostial perfusion for aortic valve replacement, some centres appear to achieve comparable results using other techniques, including normothermic ischaemic arrest. It is obvious, therefore, that many patients requiring aortic valve replacement can tolerate short periods of myocardial ischaemia. It is not certain, however, that this applies to older patients with significant coronary artery disease.

Table 8 briefly reviews results from other centres reporting experience with combined aortic valve replacement and aortocoronary bypass graft surgery. Individual techniques vary, but the reported series bear one thing in common: the vast majority of patients in these series underwent aortic valve replacement before coronary artery bypass, the rationale being, presumably, that coronary bypass before aortic valve replacement was unnecessary and/or made subsequent valve surgery technically more difficult. Our experience indicates that neither of these objections is valid. Our low operative mortality and low incidence of myocardial infarction attest to the efficacy, if not the necessity, of this

Table 8 Operative techniques and results—combined aortic valve replacement and aortocoronary bypass surgery

Author (year)	AVR before CABG	Hypothermia	Coronary perfusion	No. of patients	Operative mortality (%)	Perioperative MI (%)*
Merin <i>et al.</i> (1973)	Yes	+	Proximal	30	10	?
Berndt <i>et al.</i> (1974)	Yes	+	None	28	14	11
Rossiter <i>et al.</i> (1975)	Yes	+	None	44	14	21
Berger <i>et al.</i> (1975)	Yes	+	Proximal	32	3	17
Loop <i>et al.</i> (1977)	Yes	0	None	80	9	10
Macmanus <i>et al.</i> (1978)	No	+	Proximal and distal	49	6	2

AVR, aortic replacement; CABG, coronary artery bypass graft; MI, myocardial infarction \*defined by standard electrocardiogram and enzyme criteria.

technique. By placing the vein grafts high on the aortic root, or individually perfusing them before proximal anastomosis, we have experienced no untoward technical difficulties in subsequent aortic valve replacement.

Interinstitutional comparisons are always hazardous, and the small number of cases in most series makes statistical comparisons difficult, even in perfectly matched patient populations. However, our results to date in patients with combined aortic valvular and coronary artery disease certainly suggest that attention to the metabolic needs of the myocardium both proximal and distal to significant coronary artery stenoses reduces the mortality and morbidity of aortic valve replacement in these patients.

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